Chapter 6 – Traffic Volume and Delay

This study examined the operation of three intersections under similar traffic loadings. The data used to evaluate intersection operation was based on traffic counts. To assure that the three intersections were examined under similar loadings, comparable study hours were used instead of the more typical peak hours.

Section 6.1 – Daily Traffic Volumes

The process of gathering hourly traffic volumes began with an examination of the daily traffic at the three intersections under examination. Daily traffic counts were collected on the approach roads to each intersection. The approach counts were then examined to see when the traffic levels at the three intersections would be the same. This approach resulted in the study team using the terminology 'study hours' rather than the more typical 'peak hours'. This process was explained in Chapters 2 and 3.

The initial statistical analysis centered on whether the hourly volumes for the three intersections could be considered to have come from the same population. If not, then the intersections could not be said to be operating under similar traffic conditions and the study design would be invalid. If the volumes were found to be similar, the data could be considered to be from one population and further analysis could be conducted. Two sets of count data were analyzed: raw traffic counts and SIDRA calculated traffic counts.

The raw traffic counts were those that were collected from the videotapes. These represent field measurements of the actual traffic flows. The SIDRA traffic counts are those that are calculated internally within the computer program from the raw counts. These counts are obtained by using equation 6.1.

$$Vol_{SIDRA} = Vol_{hour} \,/\, \text{Peak Hour Factor} \qquad (6.1)$$

The null hypothesis for testing both the raw and SIDRA traffic counts was that the three intersection count means were equal (see equation 6.2). This hypothesis was evaluated using the analysis of variance F-test. For the raw traffic counts, the resulting p-value was 0.2058. This p-value is greater than the stated alpha value of 0.05, which results in the test failing to reject the null hypothesis. The raw counts can therefore be considered to have come from the same population and the intersections can be said to be operating under similar conditions.

$$H_o\text{:}\ \mu_{CG} = \mu_{DW} = \mu_{JP,} \qquad \alpha = 0.05 \qquad (6.2)$$

Section 8.1 presents the results of the statistical testing on the SIDRA traffic count data showing that the three sets of data came from the same population.

Section 6.2 – Intersection Delay

Vehicles operating through an intersection experience two distinctive types of delay: geometric and queuing *(3)*. Total vehicle delay is the sum of both types of delay.

Geometric delays are defined as those delays encountered during travel through the intersection. Geometric delays are measured as the time it takes a vehicle to traverse the intersection from entry point to exit point. It may be appropriate to include these delays in a cost analyses to account for the extra time it may take vehicles to travel around the middle island of a roundabout *(13).* Geometric delays are highest for left turn maneuvers where a vehicle must travel around the central island of a roundabout. U-turns are not included here as they are not possible at most non-roundabout intersections).

The other type of delay is operational. This is the delay that occurs when entering vehicles are delayed by the presence of vehicles already in the intersection. A 1994 report presented the operational delays through intersections under roundabout control and comparable two-way STOP controlled intersection using the NETwork SIMulation (NETSIM) computer method. The results of the comparison found that roundabouts operated better (less delays, stops, and higher average speed) than the best two-way STOP controlled intersection. In conclusion, "(t)he study also shows that the measures of effectiveness can be improved by converting the two-way stop intersections to traffic circles" *(12).* The Savage study dealt with a physical intersection design for roundabouts, not traffic circles as currently defined.

A New York study of intersection operations found the following behaviors present at roundabouts:

> "Delays occur at the exits as well as the entrances, with weaving movements taking place between vehicles leaving the roundabout and those entering just upstream…. It is common to have an upstream exit affect a downstream entry…. It is unusual to have a downstream entry affect an upstream one" *(6).*

The New York study observations were possible through the use of an omnidirectional camera that could video all approaches at once as was done in this study.

Section 6.3 - Delay at the Manhattan Roundabout

Vehicle Delay was one of the measures of effectiveness used in the study of the Manhattan roundabout. This value was not measured directly in the field, or from the video collected for data purposes, but was obtained from calculated computer output of operation at the roundabout.

Hourly count data was input into SIDRA where one of the outputs was vehicle delay. SIDRA provided average vehicle delay by approach and for the entire intersection. Vehicle delay was examined in two ways.

Overall intersection average delay represents the total delay experienced by all entering vehicles divided by the total number of entering vehicles. This value is commonly used to generate an intersection level of service (LOS) value. LOS was not used in this study because all hour periods evaluated were found to operate at LOS 'A' at the intersection level and most approaches operated at the LOS 'A' level with the remaining operating at LOS 'B'. Average vehicle delay was used as it provides a more precise measure of intersection operation than LOS.